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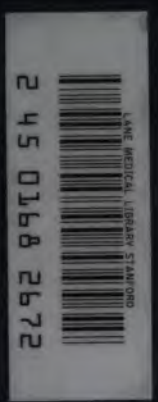
The Progress of Preventive Medicine during the Victorian Era. 1837–1887



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ON

THE PROGRESS

OF

PREVENTIVE MEDICINE

DURING

THE VICTORIAN ERA.

Being the Inaugural Address delivered before the Epidemiological Society of London, Session 1887-88.

BY

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ON THE PROGRESS OF PREVENTIVE MEDICINE DURING THE VICTORIAN ERA.

By R. THORNE THORNE, M.B.Lond., F.R.C.P.,
Of H.M. Local Government Board, President of the Epidemiological Society of London.

Her Majesty the Queen ascended the throne on June 20th, 1837. She has now reigned for fifty years, and there are but few phases of the great and all but unhindered progress which has been so marked a feature of the Victorian Era that have had a greater effect for good upon her people than that which has had to do with the improvements affecting public health. Review of the advance thus made in all its branches would cover too large a field for me to deal with in this address, but I shall venture to lay before you some account of that progress, in so far as it has been identified with the development of Preventive Medicine and Epidemiology in this kingdom; feeling sure of your interest in an endeavour to place on record, in this Jubilee year, some account of a movement which, whilst it has effected a saving of life, and a prevention of disease on a scale the magnitude of which it would be difficult to define, has done so much to elevate the condition of man, and to bring health and happiness to an untold number of British homes.

In the year of the Queen's accession one of the greatest hindrances to progress in the prevention of disease was

removed by the passing of the Act for the Civil Registration of Deaths, as well as of births and marriages. There had, indeed, been some partial registration of deaths since the date of Queen Elizabeth; the London weekly Bills of Mortality, first commenced in 1593, had been uninterruptedly continued from 1603 to 1831; but the system gradually became less rather than more efficient. Even before 1593 certain records had been kept which chronicled the periodic devastations of this country by famines and epidemics; black death, sweating sickness, and plague being prominent amongst the latter. Later on came other records, medical and historical, supplying information, more or less inexact and incomplete, as to large and often sustained mortalities from small-pox, scarlet fever, influenza, and what appeared to be typhus and diphtheria, as well as from other allied epidemic diseases. The last of these epidemics was due to cholera, which made its first appearance in the United Kingdom in October 1831, and from which, in the following year, many thousands perished. But no registration of the causes of death existed at the time, and hence, although 52,547 cholera deaths were heard of from various sources as having occurred in the United Kingdom during that epidemic, yet the actual extent of cholera fatality remained unknown. Such statistical information as was available up to 1837 was all but useless for scientific purposes; death-rates were calculated on no certain data, and their significance was correspondingly open to question. The first requisite to a proper understanding of the etiology of disease was wanting, and epidemics were looked upon as enveloped in inscrutable mystery, and as far beyond human control.

But, in 1837, better machinery for the compilation of vital statistics was provided; and when Dr. William Farr entered the office of the Registrar-General of England, in 1839, those first steps were taken to secure such classification and grouping

of deaths from various causes and in various localities, on sex, age, and condition of life, as have so largely contributed "to demonstrate the principal springs" of health and mortality. For no class of diseases was this more needed than as regards that group which appeared in the form of epidemics; concerning which, as Dr. Farr tells us, man could only "whisper of telluric and meteoric influences"—unless, indeed, some "comet was at hand to account for the phenomena". There was, in short, the grossest ignorance as to the group of so-called epidemic, endemic, and contagious diseases, the prevalence of which had formed epochs of chronology, affected the stability of cities, states, and governments, and brought wide-spread misery to communities and individuals.

The first publication of Abstracts of Deaths began to throw some light on the behaviour of epidemics, and the records indicated that, with a population which in 1831 had numbered some fourteen millions in England and Wales, infectious diseases were causing large mortalities. Thus, in the ten quarters from July 1st, 1837, to December 31st, 1839, we can trace the march of an epidemic of small-pox which destroyed at least 30,819 persons in England and Wales; and it became evident, from the facts learned as to the incidence of the disease, that the rate of mortality increased with the density of the population, and that the extension of the infection was differently disturbed by the protection which some persons derived from vaccination, and by the artificial diffusion of the malady which accompanied the practice of small-pox inoculation. In 1840 scarlet fever was the reigning epidemic, the deaths from this cause having steadily increased from 5,802 in 1838 to 19,816. Diarrhœa, dysentery, and so-called cholera formed a group which was also causing a large mortality, and the distribution of the three affections was such as to make it in practice difficult to draw a line between them and those forms of diarrhœal disease which

assumed epidemic characters. Attention was also, in 1840-41, attracted to the heavy mortality from "typhus", a term under which all the fatal attacks of continued fever were at that time registered. Already, the dothinenteria of Louis, the enteric fever of our day, was referred to in British statistical returns as in all probability different from typhus, though there is good reason for believing that at that date much of our "fever" mortality was in reality due to true typhus. Thus, in 1841, the excess of the "typhus" death-rate in towns over that obtaining in the country was 56 per cent. This fact, indeed, led to a further examination of the difference in the general death-rate of towns and country districts, and it was found that, whereas the annual mortality per cent. of population was 1·8 in country districts, it was as high as 2·6 in town districts; and in 1841 the Registrar-General pointed out that, whereas the mean duration of life in Surrey was 45 years, it was not more than 37 in the metropolis, and only 26 in Liverpool. Pulmonary consumption was also now ascertained to be one of the diseases which exhibited a striking excess in the case of town life. In fact, the general mortality was found to be increased 44 per cent. by the then condition of English towns and cities, and much that led to this excess of death was rightly held to be capable of remedy.

Some account of the principal diseases which I have thus incidentally referred to, namely, small-pox, typhus, enteric fever, scarlatina, diphtheria, phthisis, and cholera, will, in the main, suffice for the purpose of illustrating the progress which I am desirous of recording. They are typical of that group of diseases which is amenable to the control of preventive medicine and to public health measures; they hold a prominent place in the history of scientific and epidemiological research during the period under consideration; and I propose briefly to review the course of each of them during the past fifty years.

I.—Small-pox.

Jenner's great discovery of vaccination—a process by which man can be protected against small-pox without himself becoming, as had been the case in variolous inoculation, a source of danger to others—was made known to the world towards the close of last century, but it was not until 1840 that the first Vaccination Act was passed which inaugurated the system of public vaccination, under which "all persons" could claim to be vaccinated at the public cost, and which has been the means of saving so great an amount of life in this country. It was also reserved for this era to extend and elaborate that system by the Acts of 1853, 1858, 1867, and 1871, and to promote and superintend the execution of those Acts by a department of the Government and by local officers. The diminution of small-pox occurring in sequence to these measures may be judged of by the following statement:—During the period 1838-42, towards the end of which the advantages of the Act of 1840 were in operation, the rate of mortality from small-pox in England and Wales was 57·2 per 100,000 living; by the end of 1849 it had fallen to 29·7, and during the period 1850-54 to 27·4. It was at this time that the Vaccination Act of 1853 came into operation. That Act embodied the principle of making vaccination compulsory on all infants within a few months of birth; and the Epidemiological Society, in a report which was printed by order of Parliament, and laid before the House of Commons, assisted in securing the adoption of this new departure, which has so largely contributed to the prevention of death from a loathsome disease. During the course of the three next quinquennial periods the small-pox rate fell further to 19·8, 19·0, and 14·4 per 100,000 respectively; the latter portion of the last period, namely, that for 1865-69, being in part in-

fluenced by the operation of the provisions embodied in the comprehensive Act of 1867.

So far, the operation of vaccination performed in one way or another could be credited with a success without parallel in the history of preventive medicine. But during the next five years—1870-74—the small-pox rate rose to 42·7 per 100,000; and although it again fell as low as 8·3 during the period 1875-79, and to 6·5 for 1880-84, yet the sudden leap upwards in 1870 afforded incontestable proof that the practice of vaccination, as it was then largely carried out in this country, had not secured for the inhabitants generally that extent of immunity from small-pox which had been hoped for; and it became evident that there was yet much to learn as to the circumstances under which an operation apparently so simple, and yet so dependent for its full efficiency on the observance of important details, could best be carried out.

One principal point elicited as the result of the epidemic 1870-72 was, that a large proportion of the deaths from small-pox had occurred amongst persons over 15 years of age who were stated to have been vaccinated; and examination of the returns went to show that a large amount of imperfect and insufficient vaccination had been practised at a period when the then adult population had, as infants, been submitted to that process.

Other considerations were also raised by that epidemic. Small-pox, both in this country and abroad, was ascertained to have been of a malignancy heretofore unknown to the present generation, and it was assumed by some that a process of vaccination which had been sufficient to protect against fatal small-pox of the ordinary virulence had failed in the presence of an infection of exceptional potency such as that which had been imported under the circumstances of the great Franco-German war.

How far such theory of an exceptional potency of infection can be held to account for the results that ensued, may be open to doubt. But other possible explanations merit attention. Thus, there is the surmise of a special receptivity on the part of those attacked. The protection which vaccination had afforded against small-pox in this country had been steadily, and to an increasing extent, given to infants during several generations, and together with its extension there had been a gradual failing of that power of resistance to attack which is believed to be inherited by the offspring of parents who have themselves suffered from a specific infectious fever, in much the same way as the transmission of physical qualities takes place. And in this way it has been explained that, just as measles in 1875 wrought such havoc amongst the inhabitants of the Fiji Islands who had had no opportunity of acquiring any immunity against the natural force of the poison by reason of heredity, so small-pox, under the circumstances of 1871, broke in upon the descendants of a people who, by reason of vaccination, had had no opportunity for transmitting to their children such resistance to attack from small-pox as had formerly been brought about by attacks of the same disease in their ancestry.

And again. When vaccination was first made gratuitous, many adults must then have resorted to it for the first time, and thus people acquired the protection attaching to a primary vaccination at an age which gave them a practical immunity against small-pox for the remainder of their lives. But as years passed on, primary vaccination during infancy became more and more general, and long intervals of time often elapsed between the performance of that operation and exposure to the poison of small-pox. The bearing of these and kindred considerations upon the epidemic of 1871-72 led to the belief that we were not yet fully acquainted with

all the circumstances under which the full effect of vaccination in its conflict with small-pox could be acquired.

At this stage, Dr. Buchanan, medical officer to H.M. Local Government Board, commenced an investigation into the influence of vaccination as a protective against small-pox, the results of which are embodied in a series of reports which form some of the most important chapters in the history of this subject, and are characteristic of the labours by which progress in this department of the science of preventive medicine has been advanced during recent years.

At the outset of this inquiry it became evident that vaccination had led to a vast saving of life during infancy and childhood. Examining into the mortality from small-pox in children under ten years of age in London, Dr. Buchanan ascertained that this mortality "among the unvaccinated was about a hundredfold the mortality from small-pox among the vaccinated";* and that if in the year 1881, which was then under consideration, the small-pox mortality amongst the vaccinated children had been at the same rate as amongst the unvaccinated, London would during that one year have been confronted with 12,000 more deaths from small-pox than actually occurred. This saving of 12,000 young lives in one twelve months was effected by the current vaccination available; but it was further shown that "the power of a thorough vaccination to protect against death from small-pox is at least ten times greater than the power of much that passes for vaccination"; and that as regards the children dying in London of small-pox within some ten years of alleged vaccination, the mortality in this class obtaining "private" vaccination was more than twice as great as in the class seeking vaccination at the hands of public officials, who are under the requirement to perform the operation accord-

* Report of the Medical Officer of the Local Government Board for 1881. [C.—3337.—I.]

ing to a recognised standard of efficiency. In short, vaccination had not failed to prevent death from small-pox during the early period of life, except in so far as the application of the prophylactic had been imperfect.

In one sense the failure, at that date, to apprehend the need for such vaccination as we have now learnt gives the highest form of protection against small-pox is not to be wondered at. The extraordinary and continuous decline in small-pox mortality during the quinquennial periods already referred to, from a rate of 57·2 per 100,000 in 1838-42 to 14·4 in 1865-69, which had followed on the extension of the system of public vaccination, was enough to lead to an undue exaltation of the influence of vaccination as such; and it required the subsequent rise to 42·7 per 100,000 during the period 1870-74 to convince those who were engaged in the study of preventive medicine that there was more to be learnt about vaccination before its full protective value could be enjoyed by the public. Much of the needed information has already been obtained. Thus, whilst no difference can be found in the protective value of lymph, whether taken direct from the calf or after it has passed through the human subject, it is known that the full effect of the operation of vaccination can only be secured by careful selection of the lymph used, and by the performance of the operation in such a way as to secure at some four or five points of insertion well-foveated scars, which shall, in the aggregate, cover at least half a square inch of surface. And, further, it is becoming more and more evident that the protective value of even an efficient vaccination is not always so enduring as many had, at first, been inclined to think; that its full effects are not unfrequently limited to a comparatively short term of years; and that, for the retention of its full protection, it calls for repetition, especially in the young, probably within not less than ten years of the first operation.

This conclusion may to a large extent be drawn from the results of Dr. Buchanan's investigations, and it is prominently brought out by the statistics published in the recent report of the Vaccination Committee of the Epidemiological Society, and which go to indicate the need for an even earlier repetition of vaccination.* From that report we learn that, during the first five years of life, when liability to death from small-pox is at its highest, the influence of recent vaccination, efficient in point of foveation, number, and total area of the resulting scars, is pre-eminent in its protective power against fatal attack; that, indeed, at all ages up to twenty years "small-pox patients having 'good' vaccination at the date of their attack, die, according to their age, from $\frac{2}{80}$ to $\frac{5}{80}$ only the extent of unvaccinated patients at corresponding ages." The value of an efficient vaccination is thus strikingly indicated.

But if the power of vaccination as such, and without proper regard to quality and frequency of its application, has in the past been somewhat over-estimated, there is steadily accumulating evidence that the proper use of this extraordinary prophylactic has a potency which borders on the marvellous. Some who profess that they do not believe in its influence for good would allege that the all but uninterrupted diminution in small-pox mortality which has followed on the extension of vaccination has been brought about by an improvement, synchronously effected, in the general sanitary circumstances to which the population have year by year been exposed. But, under the same circumstances of treatment, unvaccinated small-pox patients die nowadays at the same, if not at a higher, rate than they died before the discovery of vaccination, while vaccinated small-pox patients die at a rate varying between one-fifth and one-fortieth of the

* Report of the Vaccination Committee. *Transactions of the Epidemiological Society*, vol. v, Session 1885-86.

rate of the unvaccinated; the difference between the one-fifth and the one-fortieth being determined by the degree of vaccination.*

Comparison of the results of exposure in hospital to the infection of typhus on the one hand, and of small-pox on the other, are of especial interest in this connection. In the London Fever Hospital there were, during the ten years 1861-70—the latest period during which typhus was received into that institution—no less than 179 attacks, and 42 deaths from typhus amongst the nurses and staff of the hospital; whereas, according to the recent report of the Vaccination Committee of the Epidemiological Society, out of a total of 734 nurses and attendants in the three small-pox hospitals of the Metropolitan Asylums Board, whence complete information was procurable, not a single re-vaccinated person took small-pox. Of these 734 members of the staff, 79 (mostly former patients) had recently suffered from small-pox; of the remainder, 645 were re-vaccinated before entering on their duties; and 10 were, for one and another reason, not re-vaccinated. Every one of the latter contracted small-pox,

* An unknown essayist, writing in *The World*, No. 127, 5th June 1755, supplies important information as to the deadly character of small-pox uncontrolled by any such protective as vaccination; and he, for the purposes indicated in his essay, contrasts it with the same disease as modified by inoculation. He states that, prior to the introduction of small-pox inoculation, London, thanks to the fatal ravages of small-pox, was tolerably roomy; people preferred to stay at home in the provinces rather than come to London and catch the disease. . . . "But now, thanks to inoculation, this danger has disappeared, and London is most inconveniently crowded." . . . "This inconvenience has, in a great measure, been hitherto prevented by the proper number of people who were daily removed by the small-pox in the natural way, one at least in seven dying, to the great ease and convenience of the survivors, whereas, since inoculation has prevailed, all hopes of thinning our people in this way are at an end, not above one in three hundred being taken off, to the great incumbrance of society."

whereas not one of the 645 re-vaccinated persons suffered from the disease.

Or again. During 1882 fourteen nurses were engaged at the Newcastle-upon-Tyne infectious hospital in attendance on cases of typhus. Of these, nine contracted the disease, and two died. In an adjacent pavilion nine other nurses were in attendance on small-pox patients. Of the nine, all but one, who had recently had small-pox, were re-vaccinated before coming on duty. None of these contracted small-pox, but one of them did catch typhus. So, also, during the same year, the Medical Officer of Health of Gateshead reported that "every nurse who has been more than a fortnight in the typhus wards has suffered from typhus; on the other hand, the only officers who took small-pox were two kitchen girls whom I neglected to vaccinate."

In each of these three groups of cases the two sets of nurses and attendants were drawn from the same class; they were fed alike, and subjected to the same sanitary circumstances. They differed in one respect only. One group of persons were fully exposed to the poison of small-pox, and being vaccinated they escaped; the others, unprotected by any prophylactic against the poison of typhus, suffered heavily, either by disease or death, from the infection to which they were exposed.

But evidence as to the value of re-vaccination is no longer limited to experiences such as I have referred to, for the story of an experiment on a gigantic scale is to be found in the report of the German Vaccination Commission.* There we find that, since the establishment of compulsory re-vaccination at the age of twelve years, "in Germany, as a whole, small-pox has diminished to a degree never before known, so far as any records reach"; whereas "in all neighbouring

* On the German Vaccination Commission. *Transactions of the Epidemiological Society*, vol. v, 1885-86.

countries small-pox is, as usual, still very prevalent"; "that the German large cities suffer scarcely at all from small-pox, which continues to demand its victims in all large foreign cities"; that "the German army is almost free from small-pox, while other armies still suffer severely"; and, lastly, that "not a single death from small-pox has occurred in the Prussian army since 1874", whereas both the neighbouring "Austrian and French armies still show considerable losses in this respect."

Reference to the knowledge recently acquired as to small-pox would be incomplete were I not to advert to the disturbing influence which the establishment of hospitals for the isolation of that disease has had upon the incidence and mortality from small-pox in the metropolis and in other towns. The investigations of Mr. W. H. Power into this matter are well known. They have been submitted to the consideration of a Royal Commission, and the whole subject has been further dealt with in Dr. Buchanan's recent reports on the proceedings of the Medical Department of the Local Government Board.* It is now generally admitted that aggregations of small-pox patients do cause an increase of small-pox in their neighbourhoods; and Mr. Power's contention that a hypothesis of the conveyance of the contagium through the general atmosphere can alone explain the circumstances of the diffusion, now meets with the almost unanimous support of competent scientific judges.

Advance in our knowledge of the natural history of small-pox, of its more obscure methods of diffusion, and of the circumstances under which the full protective effects of vaccination are to be acquired against this terrible scourge, has

* Reports of the Medical Officer of the Local Government Board: On the Use and Influence of Hospitals for Infectious Diseases, 1882 [C.—3290]; Annual Report for 1884 [C.—4156]; Annual Report for 1885 [C.—4844—I]; and Annual Report for 1886 [C.—5171].

characterised the past fifty years; and although the record of a steadily diminishing small-pox death-rate was at one point marred by the circumstances of the period 1870-72, yet even that experience will have tended to a useful end, if only the striking lessons it has taught are but applied to the further control of this eminently preventable disease.

II.—Typhus Fever.

Review of Typhus, and of the influence of sanitary measures upon it in this country, are greatly hindered by the circumstance that it was not until 1869 that the different forms of continued fever were separated in the mortality returns of the Registrar-General. But there is abundant evidence to show that typhus was widely prevalent during the earlier portion of the half-century we are considering, in many of our large cities, where poverty, over-crowding, and the resulting depressing influences were at work. In 1837 the disease was prevalent in several parts of the United Kingdom. In the period 1846-48 a typhus epidemic of terrible magnitude followed on an extensive failure of the potato crop in Ireland, which had brought about a vast amount of wretchedness and famine; and from Ireland the disease was imported into and spread in several of the large cities of England. About this date typhus was first discriminated in hospital returns from relapsing and from enteric fever; and the epidemic prevalence of the disease in London in 1848 is shown from the fact that 786 cases of typhus came under treatment in the London Fever Hospital during that year. In 1856 the typhus admissions into the London Fever Hospital reached 1,062. Another epidemic commenced in Ireland in 1861, and in the following year the disease was again widely prevalent in London. Indeed, the records of the London Fever Hospital show that during the period

1862-70 a long-continued prevalence of typhus was maintained, the admissions being 14,589 in all.

Since 1869 there has been an almost continuous decrease of typhus deaths in England, the fatal attacks falling from 4,281 in that year to 318 in 1885; the corresponding rates per thousand living being 0·19 and 0·01. And, in seeking the causes of this vast improvement, some reference to the incidence of the disease in London and Liverpool may be opportune. The conditions that bring about epidemic typhus are now but too well known. The disease is essentially associated with over-crowding and destitution; the depressing influence resulting from those circumstances being amongst the most powerful of its predisposing causes. Both in London and in Liverpool its prevalences have been mainly on those localities where houses have been so densely massed together on area as to preclude free movement of air about them, and where there has been such overcrowding of persons in dwellings as has ensured the fouling of the air within them by the concentrated emanations of living bodies. The incidence of the disease has also been essentially on the pauper and badly housed elements of the community.

In London there were 716 typhus deaths in 1869; but since that date this mortality has undergone rapid and almost continuous decrease, until in 1885 there were only 28 such deaths; the decrease in the rate per thousand living during the same period having been from 0·23 to 0·01. But even these death-rates do not tell the whole story of the disappearance of this disease; for of the deaths which have in recent years been attributed to typhus in the metropolis, the majority have not been true instances of that disease.

In considering the circumstances under which the blot of our metropolitan typhus record has been so largely effaced, I would call to mind some of the conditions which affected the housing of the people during the earlier part of

the past half-century. Writing in 1849, Sir John Simon, K.C.B. (then Mr. Simon), drew public attention to the existence of localities within the City of London which were so irremediably bad that no mere provision of wholesome water-supply and drainage could bring healthiness to their inhabitants. These localities exhibited complicated turnings, narrow inlets, close parallels of houses, and high barriers preventing light and movement of air. There were "courts and alleys hemmed in on all sides by higher houses, having no possibility of any current of air, and (worst of all) sometimes so constructed back-to-back as to forbid the advantage of double windows or of back doors, and thus to render the house as perfectly a *cul-de-sac* out of the court, as the court is a *cul-de-sac* out of the next thoroughfare."* The inherent vice of these houses was the lack of means for through-ventilation, and amidst it all there was "a dense population of human beings with an atmosphere hardly respirable from its closeness and pollution." "Typhus", it is added, "prevails there . . . . not as an occasional visitor, but as a habitual pestilence." Passing on to 1865, Mr. Simon, then medical officer of the Privy Council, in dealing with the question of the house accommodation for the poorer classes in towns and cities, generally adverts again to the sources and distribution of metropolitan typhus, and in his report he condemns especially the then "tenement-houses", the evils of which combined to constitute "one monstrous form of nuisance", where overcrowding reached a proportion that "no obtainable quantity of ventilation" could keep the air of the dwelling free from hurtful contamination, and where the houses, large but densely peopled, were "often without a span of court-yard, either front or back", and where the influence was so degrading, that to children "born under its curse" it must

* John Simon, *Public Health Reports*, vol. i, p. 57. London, J. and A. Churchill.

often have been "a very baptism into infamy". At this date some 2,000 cases of typhus were annually received into the London Fever Hospital; the subjects of this preventable fever being largely derived from localities such as have been indicated.

But great changes as regards the circumstances of the housing of the poor and working-classes of London were already in progress; and, since then, most of the old typhus-haunts have been demolished. Great thoroughfares, bringing with them light and air, have been cut through dense aggregations of houses; courts and alleys have been opened out, their exposure to the public gaze often leading to their being altogether swept away; and a vast number of unhealthy dwellings have been demolished. Healthy dwellings have also replaced the unhealthy ones; and a large expenditure of money has been incurred in attaining these objects.

I have not found it possible so to arrange the various proceedings that have been taken in this direction as to trace their influence, in point of time, upon the reduction of the London typhus mortality; but I would note that between 1856 and 1887 a sum of over 14 millions sterling has been devoted by the Metropolitan Board of Works to measures tending almost exclusively to the destruction of unwholesome house property, and to the opening up of wide thoroughfares and breathing spaces in crowded parts of the metropolis. And this sum does not include over two millions spent on the Thames Embankments; neither does it take any account of outlay in the erection of wholesome dwellings to replace unwholesome ones—this latter work having been almost altogether undertaken by bodies and individuals having no access to the public purse. Thus, the Company of which Sir Sydney Waterlow is Chairman has, during the past twenty-five years, provided model-dwellings for 25,000 persons; some £440,000 has been spent within the City

precincts in artizans' and labourers' dwellings, and such bodies as the Artizans' and Labourers' and General Dwellings Company, and the Peabody Trustees, have laboured in the same direction. Indeed, an intimate relation must be admitted to exist between these efforts and the disappearance of London typhus.

The same inference may be drawn from the circumstances of typhus in Liverpool, though the data are somewhat different. In 1840 no less than 40,000 of the inhabitants of that city lived in cellars—"dens into which sunlight never penetrated, and vile-smelling"; and it was well asserted that from such dwellings no amount of disinfection could banish typhus; whereas, on the other hand, the so-called "open courts" remained on the whole healthy, and this even in districts "smitten with fever". In 1843 it was found that no less than 55,534 of the inhabitants lived in courts nearly one-third of which were closed at one end, so that no through-ventilation was possible; and such preliminary measures as were adopted, or in contemplation, for dealing with this serious condition received a fatal check when, in 1847-49, an already densely over-crowded city had to face the great immigration of a destitute population seeking to escape the miseries of the Irish Famine. Writing in 1866, Mr. Simon refers to a munificent beginning of work, for the purchase and destruction of dwellings "unfit for habitation" in Liverpool, where £100,000 was then being devoted to this purpose. But the work to be performed was a gigantic one; and, judged by the needs of that city, the progress was but slow. In 1882 Dr. Stopford Taylor reported that there still remained, in illegal occupation, 945 cellars in streets, and 165 in courts; and, even as recently as 1884, Mr. E. T. Stephens, a member of the Liverpool Town Council, in his evidence before the Royal Commission on the Housing of the Working Classes, referred to a report made in 1865, in which the then

Medical Officer of Health spoke of an overcrowded group of streets in which the fever mortality was between two and three times as great as for the borough generally; and the witness added, "I can see no substantial improvement in the character of those streets since the date of that report"—twenty years ago. He further stated that there remained between 15,000 and 16,000 unsanitary dwellings in Liverpool. Another witness said that no less than "70,000 persons" in the borough still needed "healthful dwellings". And in the same year, Dr. Stopford Taylor, in dealing with the conditions of Liverpool typhus, recorded a number of instances which emphasise every phase of that misery which attaches to this disease in its relation to destitution amongst a people living under aggravated conditions of overcrowding and aerial filth.

The following are typical illustrations:—

"Margaret Carroll, age 11, 9 The Bower, 9 Court, Gore Street. The child has been about fourteen days ill. She lies on rags, in a state of great filth. The house is almost bare of furniture, and the people appear to be destitute. There are two or three other starved-looking children, and the mother wears only a single garment. The father, a strong, able-bodied man, tremulous with drink, volunteers the opinion that the child is suffering from want of food, and not from fever. He also states that he has been drinking hard for the last fourteen days, and considers that drink is more easily got than food."

"Matilda Crosby, aged 35, 1/13 Eaton Street. The poor creature in this filthy and abominable court has been five or six days ill. The room is so dark as to necessitate the use of wax matches to examine the patient. The room is foul and filthy, almost bare of furniture, and the other inmates are clothed with rags. Two or three half-naked children bear evidence of chronic starvation."

"Melaney, 6/1 Hughson Street. The intense fœtor of the room in which the sick people lay necessitated waiting outside until the window was opened. The occupants of the bed, which is about 3 feet by 6, were five in number, and all exceptionally filthy. The mother is a fish-hawker, and the fish were in a basket under the bed. The family appeared to be suffering from chronic starvation, and two members had fever. The upper rooms of the house were sub-let."

"Lizzie Thompson, aged five, 7/2 Rankin Street. The child has been sick about nine days. There is another child, aged about four years, who

has recently been ill, and is now convalescent. The mother states that during the last two weeks the income of the family has been 4*s.* 6*d.* per week, and they have no other money nor relief. Her face bears the imprint of chronic starvation, and the surroundings confirm her story."

"Mumford, 1/13 Upper Frederick Street. Three persons, viz., the father and two children, are sick in this house, which is miserably furnished, filthy, and foul-smelling from the dirty skins and clothing of the inmates. The mother states that for seventeen weeks the income of the family, derived from the earnings of the father, has been 7*s.* per week. In reply to the inquiry as to how they were living, the mother replied, with some emphasis, 'they were not *living*, but *starving*.'"

But, gradually, a number of these conditions have been ameliorated, and within recent years even more substantial efforts have been made to cope with them. Amongst these I would mention the provision of healthy homes by the Liverpool Labourers' Dwellings Company, Limited; and the fact that, under a Sanitary Amendment Act of 1864, there had been expended up to the close of last year, and for the purposes in question, a sum of nearly £199,000; and an expenditure of £141,000 for works under Cross's Act, in the demolition of crowded areas and in the erection of wholesome dwellings. The precise effect of these several measures on the diminution of typhus cannot be traced, for it was not until 1877 that typhus became a separate entry in the borough records. But it deserves notice that, whereas in 1877 there were 204 such deaths, they fell to 96 in 1880; and though during the three years 1881-83 typhus again became prevalent, and caused 1,030 deaths; this was followed by a marked diminution and a record of only 71 fatal attacks in 1885, and of 45 in 1886; this latter being the lowest number ever yet recorded in any one year.

At this stage allow me to recall the fact that, as far back as 1849, Mr. Simon referred to back-to-back houses in connection with typhus. And he by no means stands alone in condemning the vicious system of so constructing dwellings as to deprive them once for all of means of through-ventilation.

Confining my remarks on this point to two sources of information which have been prominent in connection with typhus prevalences, I would quote the opinion of the experienced Health Officers of Glasgow and of Liverpool. In his evidence before the recent Royal Commission on the Housing of the Working Classes, Dr. Russell declared that "these back-to-back houses are the curse of Glasgow". In Liverpool they have been described by successive officers as "blind houses"; "houses only open to the front"; "houses back-to-back, and only one room deep"; or, more recently still, as "straight-up" houses. And they are never mentioned except in terms of reprobation, as violating the first principles of health, and as having a marked connection with the persistence of typhus.

Having regard to facts such as these, the Local Government Board have embodied in their model code of bye-laws as to new buildings, clauses requiring that every new domestic building shall have, both to the front and to the rear, a defined minimum amount of open space; and the Board make it a practice to refuse confirmation of such codes as do not embody this principle. And the Royal Commission of 1884 have also made a recommendation to the effect that a similar requirement should be enforced, even under the difficulties of the metropolis, where the cost of building-land is so excessive.

Thousands of lives have been sacrificed to the greed and ignorance under which houses have been aggregated together in disregard of the requirements of health. Millions have been spent in endeavouring to undo the mischief wrought by past generations in this respect; and if we consider alone the relation of typhus to that uncleanliness of air which results from the concentrated emanations of human bodies, we have abundant ground for demanding that a check shall be placed on all who, for one motive or another, would interfere

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with that free movement of air around our future dwellings which is so essentially necessary for the prevention of disease.

III.—Enteric Fever.

During the early part of the half-century we are considering, many able workers were engaged in research which had for its object to determine whether the "fever" mortality of this country was due to one or more distinct and separate diseases. English, French, and German pathologists had alike noticed the special lesions which we now know to be pathognomonic of enteric fever; and in Glasgow the fact was early recognised that two altogether different eruptions were met with in the "fever" wards. Much the same conclusions were being arrived at in the United States. In this country, where both typhus and enteric fever were commonly prevailing side by side, it was not until 1840 that it was made clear that the rose-spot eruption and the intestinal lesion of Peyer's patches were characteristic of enteric fever, and incompatible with true typhus. In that year the late Dr. A. P. Stewart, in a masterly description, indicated the more prominent differences between the two fevers, declaring that their characters were "so marked as to defy misconception". Besides which, he went so far as to point out that there were differences in the circumstances under which the two diseases occurred.

But this doctrine of the non-identity of the two diseases was by no means universally accepted, and it remained for Sir William Jenner, as the result of his researches, published between 1849 and 1853, to clear up all further doubt on the subject. And he did more. He showed conclusively that the two diseases by no means necessarily prevailed together; that the one did not communicate the other; and, above all things, he made it clear that they depended on different causes.

Accurate observation of the symptoms, natural history, and pathology of disease has ever been at the foundation of progress in preventive as in curative medicine; but there probably never was an occasion when so much depended on correct diagnosis as when these two diseases were once for all dissociated from each other. So long as one "fever" was alone recognised, the fatality which on the one hand attached to our jails, camps, and city tenements, where misery and excessive crowding obtained, was confused with that which, on the other hand, occurred alike in the mansions of the wealthy—to which sewer-air had by ill-contrived arrangements been laid on—and in scattered rural districts, where the need for the proper disposal of excreta was not yet recognised. This confusion of the two diseases barred the way to progress in preventive medicine; for the causation of that which seemed but one disease, and which yet appeared under such widely differing circumstances, long defied detection. But, when once the distinction was made, the road was clear. The remedy needed for the prevention of the one disease had little or nothing in common with that for which the other called; and whilst the removal of conditions favouring that form of filth which comes of an air laden with the accumulated emanations of a crowded and destitute people rid our towns of typhus, it was found necessary, for the prevention of enteric fever, to cope with the varying circumstances under which poisoning by means of the excreta of populations could operate, either through water and food consumed, or through air breathed. Medical science having once indicated the directions in which remedial measures were needed, the work of prevention could be intelligently pushed forward; and I may truly say that its rapid advance, and the widespread benefits resulting from it, have been largely due to the impulse given by the skilfully discovered differentiation of these two continued fevers.

It was not until 1869 that enteric fever and simple continued fever were separated, for the purpose of death registration, from the general body of "fever" deaths. From that date the records concerning them are distinct; but in any reference to them before 1870 they must be dealt with collectively.* In 1869, the number of fatal attacks from enteric and simple continued fever in England and Wales was 13,967, and in the years that immediately followed but little diminution is to be observed in their fatality. During the five years 1876-80 the average annual number of deaths had fallen to 8,657, and in the period 1881-85—and this notwithstanding a steady increase in population—it had fallen to 6,671. Or, comparing the annual death-rate per thousand living in 1869 and in 1885, I find that they were 0·39 and 0·17 respectively in the case of enteric fever, whilst for simple continued fever they were 0·24 and 0·02 respectively—a sufficiently marked decrease in both cases.

Before the period for which these comparisons can be made, it had been shown, by means of reports and otherwise, how urgently our towns and cities stood in need of proper means of drainage and water-supply. In 1849, Mr. Simon pointed out, as regards the City of London, how often a cesspool was to be found "actually within the four walls of the inhabited house; the latter reared over it, as a bell-glass over the beak of a retort, receiving and sucking up incessantly the unspeakable abomination of its volatile contents"; and it is notorious how generally wells were resorted to which were sunk in a filth-laden soil, and how even public water-services were so contrived as to give a minimum supply with the maximum amount of trouble, and often with a

* With reference to the interpretation to be put on the term "simple continued fever", see Dr. Longstaff's paper in the *Proceedings of the Epidemiological Society*, New Series, vol. iv, on "The Seasonal Prevalence of Continued Fevers in London."

large share of danger. These and kindred matters were shown to be prevailing on a wide scale during the period in which the General Board of Health instituted its long series of public inquiries. And, again, after Mr. Simon had for nine years held office as medical officer to H.M.'s Privy Council, he still found it necessary continuously to advise—1st, that, by appropriate structural works, all the excremental produce of the population shall be so promptly and so thoroughly removed that the inhabited place, in its air and soil, shall be absolutely without fœcal impurities; and, 2nd, that the water-supply of the population shall be derived from such sources, and conveyed in such channels, that its contamination by excrement is impossible.* And, as regards enteric fever, he went on to show—by reference to Dr. Buchanan's well-known report on the results gained in various parts of England, by works designed to promote public health—how remarkable had been its diminution since the execution of efficient sanitary works. To quote a few examples only. Comparison between the enteric fever annual death-rate per 10,000 people living after the execution of such works, with that for periods which had preceded them, showed that there had been a fall at Merthyr Tydvil from $21\frac{1}{3}$ to $8\frac{2}{3}$, at Croydon from 15 to $5\frac{1}{2}$, at Ely from $10\frac{2}{5}$ to $4\frac{1}{2}$, at Penrith from 10 to $4\frac{1}{2}$, and at Stratford from $12\frac{1}{2}$ to 4.

In the meantime another great advance had been made. Although it had long been an accepted doctrine that filth was in some way related to the production of disease, yet but little was known, during the earlier part of the present reign, of the actual means by which conditions of filth affected health; and many of the works which had been carried out, and which had led to results such as I have referred to, were primarily adopted for the prevention of nuisance.

* Ninth Report of the Medical Officer of the Privy Council, 1866.

But it had now come to be regarded as the result of etiological research that the great potency of filth for mischief lay in the fact that it formed a nidus for the multiplication and spread of definite and specific contagia of disease; and it is largely to the apprehension of this important principle that the vast expenditure for sanitary works which has characterised the past quarter of a century has been due.

But even in places where works aiming at the safe disposal of the solid and liquid refuse of populations, and at the provision of wholesome water-services, had been carried out, periodic, and at times large, outbreaks of enteric fever still recurred, and it remained for those engaged in epidemiological research to discover those more obscure channels through which the infection of this fever was at times conveyed to man.

In May 1858, Dr. Michael W. Taylor wrote a paper in the *Edinburgh Medical Journal* on "The Infection of Fever by Ingesta", in which he suggested that an outbreak of what we know now to have been enteric fever was due to specific contamination of milk, derived from a dairy where the disease prevailed. This report received but little publicity. It was followed in 1870 by a report from Dr. Ballard, then Medical Officer of Health for Islington, who had succeeded in tracing a prevalence of the same fever to the distribution of a particular milk-service. Within less than a semicircle of a quarter of a mile radius, 168 cases of that disease occurred within ten weeks, and the occurrence could not be explained by any of the ordinarily recognised means with which the spread of that disease was then known to be associated. Gradually a suspicion arose that there was some connection between the outbreak and the use of milk from a certain dairy; but the idea was still a novel one, and it was only after further exhaustive investigation that Dr. Ballard was at last in a position to demonstrate that connection as the true explanation of

the disease. Out of 140 families supplied from the dairy in question, there were no fewer than 70 attacks, with 30 deaths, the disease picking out, as it were, its victims from the homes of the dairy customers living widely apart, in different streets and squares, and showing a marked incidence on large consumers of milk. And, finally, it was ascertained that water from a tank in direct communication with some old drains had been used for dairy purposes. The report in which Dr. Ballard announced the discovery he had made was, at the time, characterised as a masterpiece of medical logic, and it is worthy of being remembered on such an occasion as this as forming one of the most striking and important episodes in the history of preventive medicine in its application to enteric fever and other infectious diseases.

In 1873 there followed the admirable report by Mr. Netten Radcliffe and Mr. W. H. Power, on a wide-spread epidemic of the same disease in West London. It was traced to the use of milk from a large London dairy, and the ultimate conclusions arrived at made it practically a certainty that the milk in question was "infected with enteric fever material", and that at the particular farm from which it was derived the water used "for dairy purposes contained excremental matters from a patient suffering from enteric fever immediately before and at the time of the outbreak."

Numerous instances of the same sort were gradually brought to light, and there were soon strong indications to show that milk formed a specially favourable vehicle for the propagation and distribution of the contagion of this and of other diseases. Outbreaks of enteric fever have since, in the same way, been traced to the use of cream; and, later on, the occurrence of infectious diseases as the result of the use of ice and iced creams prepared with materials containing the specific

poison of disease, went to prove that the process of freezing did not suffice for the destruction of the contagia in question.

And, more recently, the frequent occurrence in this country of enteric fever in connection with milk-supplies has led observers to consider how far it is possible that this affection may have a starting-point in some bovine disease; whilst Dr. James F. Allen, Medical Officer of Health to the Corporation of Pietermaritzburg, has gone so far as to contend that his South African experiences warrant him in the conclusion that there is a disease in cows and calves allied to that of enteric fever in man, and he holds that there are strong grounds for believing that enteric fever may be produced in man by means of milk from cows suffering from the corresponding bovine disease. The subject is an important one, and it is sure to receive the careful consideration of epidemiologists.

In the meantime a new channel for the dissemination of enteric fever had been discovered. In 1873, Dr. Blaxall, during the course of an inquiry into an outbreak of enteric fever at Sherborne, had found that, during intermissions in a public water-service, foul matters had facilities for getting into water-mains; and in the following year Dr. Buchanan was able to show conclusively that a localised spread of enteric fever in Caius College, Cambridge,* had been mainly due to the suction of specifically contaminated air and other matters into the water-pipes of a particular portion of the college during intermissions in the water-service, and to the subsequent mingling of this air with the water used for drinking purposes. And late in the same year I had occasion to trace an epidemic of the same disease in Lewes to a precisely similar cause. In this instance a wide-spread diffusion of the disease took place, and no less than 486 attacks, with

* Report of the Medical Officer of the Privy Council and Local Government Board. New Series, No. II, 1874.

some 40 deaths, resulted before the mischief could be checked by the substitution of a constant for an intermitting water-service. Since that date the conditions under which intermitting water-services become dangerous to the public health have been very generally recognised, and, as a consequence of investigations such as I have referred to, additional measures for the prevention of enteric fever have become practicable.

Year by year evidence was accumulating to show how great was the potency for mischief of even minute portions of the specifically diseased evacuations of enteric fever patients when such matter was placed under circumstances favourable to its multiplication and its communication to man. One of the most striking instances of this potency occurred in the epidemic of enteric fever which I had to investigate, in 1879, in the wide area over which the Caterham Water Company distributed their supply.* In that case 352 cases of enteric fever took place at Caterham, Redhill, and certain intervening places, some 200 of the earlier cases being traced directly to the use, during a particular fortnight, of water derived from a deep well, in which a man suffering from that disease had been employed, under circumstances which left no possible doubt that his excreta had got access to the well-water. In this case it was estimated that, after all possibility of further pollution had come to an end, no less than 1,861,000 gallons of water had been pumped from the well during the fortnight in question; and Dr. Buchanan, in dealing, in his annual report for 1881,† with the question of the amount of specific pollution which might suffice to render a potable water dangerous, showed that, in this case,

* Annual Report of the Medical Officer of the Local Government Board for the year 1879. [C.—2681—I], 1880.

† Annual Report of the Medical Officer of the Local Government Board for the year 1881. [C.—3337—I], 1882.

the water could have contained no such amount as one grain of excremental matter per gallon; and he brought forward considerations tending to prove that an amount of specifically polluting matter so infinitesimal in quantity as to be altogether beyond detection by chemical analysis was fully potent for mischief.

It may, indeed, now be claimed as one of the most settled principles of preventive medicine that all excremental filth, irrespective of its quantity, must be regarded as potentially noxious to man; and that, for the prevention of such a disease as enteric fever, "the one essential is cleanliness." Measures based on this principle have already done much to diminish the amount of sickness and death which were formerly the result of enteric fever. But much still remains to be done, and it will be the duty of epidemiologists to continue the study of the etiology of this disease, and the detailed history of its occurrences, with a view of learning whether there are not still undiscovered means by which its contagium becomes communicated to man.

IV.—Scarlatina.

Scarlatina is a disease the mortality from which in England and Wales has, from time to time, exhibited very extensive fluctuations. The first decennial summary of the Registrar-General showed that during 1851-60 the deaths at all ages from this disease amounted to 88 per 100,000 living; in the next decennial period, 1861-70, the rate had risen to 97; but during the ten years 1871-80 there was a substantial diminution, the rate standing at only 72. Since 1878, when the rate was 75 per 100,000, it has fallen year by year without interruption, until, in 1886, it was in the proportion of only 17 per 100,000 living. There is, perhaps, no disease concerning which it can be said with less cer-

tainty that diminutions year by year in its fatality foretell a permanent lessening in its prevalence than is the case in regard of scarlatina. Not only do different outbreaks vary very greatly as regards mortality, but the epidemic prevalences tend to occur in cycles; and an abatement extending over a few years has been known to be followed by a wide and fatal diffusion of the infection. And not only so, but the more recent diminution in the amount of fatal scarlatina may be in noteworthy part matter of diagnosis; thus, whereas many deaths which are now registered as due to diphtheria were formerly returned under the heading of scarlatina, or scarlet fever, the difference between the two diseases is year by year becoming more recognised, and the fatal attacks are not confused under one name to the extent that was formerly the case.

But, after making every allowance, there remains the important fact, that ever since the decennial period 1861-70 there has been a very general and fairly steady diminution in the fatality of scarlatina in this country, until, in 1885, the rate of death from that cause was less than a quarter of that which formerly prevailed; and it is impossible not to regard so long-continued and marked an abatement as an indication that some of the means conducing to the spread of this very fatal fever have been materially restricted.

And to those who are engaged in the study and practice of that branch of medicine which has prevention for its main object, the fact is the more satisfactory, because it must be admitted, with respect to scarlatina, that the great saving of life indicated in the statistics quoted has, in the main, been brought about by epidemiological research, and by the resulting intelligent apprehension on the part of the public of the methods by which the specific contagion of this disease may be multiplied and is communicated to man. Scarlatina has no such relation to works of water-supply and drainage

as have those other preventable diseases of which enteric fever is a type, and such effective action as has been taken to check its ravages has been based on a growing scientific knowledge of the etiology of the disease.

Up to a comparatively recent date all the more generally adopted means of prevention were in one way or another included within such processes as had to do with the isolation of the sick from the healthy, and the disinfection or destruction of such articles as were known to act as vehicles for the infection. And it may be recorded with satisfaction that, apart from such measures as are now adopted by private individuals, many public bodies have come to regard it as a duty to take such action as lies in their power to stay the diffusion of this disease. Thus, several hundreds of the Sanitary Authorities of England and Wales have provided their districts with isolation hospitals, and with means of disinfection; and measures have been initiated under the auspices of the Education Department of the Privy Council with a view of staying the dissemination of infection through the agency of elementary schools.

But a record of some of the principal phases by which our knowledge of scarlatina has from time to time been added to will go to show that, stage by stage, we have had to deal with newly discovered conditions favouring the spread of the infection—conditions lying beyond the limits of the ordinarily recognised means of personal intercommunication; and, also, that we have now arrived at a critical point in the natural history of this disease—a point at which it is evident that we shall, in the future, have largely to rely on the skilled co-operation of those who devote themselves to the study of disease in the lower animals.

I believe that Dr. Michael W. Taylor, of Penrith, was the first to record an occurrence of scarlatina in connection with a milk-service. He did so in August 1870; the history

which he gave being that of a prevalance of the disease in Penrith, where the customers of a certain dairy were so largely attacked that "there was only one house containing children, which continued intercourse with the dairy to the end, that escaped the hurtful influence." It was ascertained that an attack of scarlatina at the dairy had preceded the general outbreak; that the dairyman's wife, who was nursing her sick child, at times milked the cows; that the milk was brought from the byre into the infected dwelling before it was given out for sale; and that a large proportion of those attacked could have had no communication with the dairy except as the result of the consumption of the milk issued from it. Gradually similar experiences were recorded by other observers, and sixteen instances in which scarlatina is believed to have followed on the distribution of special milk-services were brought under the notice of the International Medical Congress of London in 1881; the evidence implicating the milk being, in a majority of instances, of the most convincing character.

It thus became a gradually accepted doctrine that scarlatina could be, and largely was, communicated through the agency of milk, and in a majority of instances there was recorded the belief that the specific contamination of the milk had been directly derived from some antecedent case in the human subject. But there remained a certain proportion of cases in which this means of contamination could not be traced; and when, in 1882, Mr. W. H. Power reported on a scarlatina outbreak which had coincided with the distribution of a special milk-service in certain districts of London,* he expressed himself as satisfied "that it was practically out of the question that the milk had become infected in any of the commonly believed ways that require a

* Report of the Medical Officer of the Local Government Board for 1882. [C.—3778—I], 1883.

human subject as the source of infection." And, further, he brought forward a series of facts, which went to show that many of the circumstances connected with milk outbreaks of scarlatina generally accorded rather with some cow-condition than with the theory of milk-infection through any human agency. And he formulated certain positive indications as to the nature of the relation between infectivity of milk and ailment of cows, "indications which arise as soon as there is seen to be probability that the milk", in a given case, "was infected when it left the animal." These views received support, from the circumstance that Dr. Klein, experimenting, in view of these considerations, with human scarlatinal material, was able to transmit to the cow a distinct disorder, and to further transmit it from the cow to other animals.

So matters remained until 1885, when a wide distribution of scarlatina in Marylebone and other London districts was traced to several separate milk-services, derived from a Hendon farm, under circumstances that induced the Local Government Board to instruct Mr. W. H. Power to investigate and report upon the subject. The conclusions which were arrived at were not long since brought under the consideration of the Epidemiological Society, and they are calculated to have a most important influence on the future of sanitary medicine as applied to the prevention of this disease, which still annually destroys some 10,000 to 12,000 lives in England and Wales.

Mr. Power's report* demands the careful and detailed study of all who are interested in the etiology of scarlatina; but on this occasion I can only refer to its more salient features. The several prevalences of scarlatina were conclusively shown to have been brought about by the use

* Report of the Medical Officer of the Local Government Board for 1885. [C.—4844—I], 1886.

of the milk from the Hendon farm; it was quite impossible to connect the means by which the milk had received its infection with any pre-existing scarlatina in the human subject; and it was clear that it was the milk of certain cows—and of those cows only—that had to do with the diffusion of the disease.

During the course of his 1882 inquiry Mr. Power had expressed the belief that there existed grounds for associating the infection of the milk with some parturient condition in the cow; and in the 1885 epidemic the scarlatina was found to be related, in point of time, to the arrival at the implicated farm of three recently calved cows, and to the use of their milk whilst they were suffering from an ailment at first sight unimportant, but which turned out to be a specific contagious and transmissible disease, which had followed on the process of calving.* And, further, when inoculation was made into calves, either directly from the diseased products of the affected cows, or by means of sub-cultures of micro-organisms connected with these substances, a disease was produced which, to quote Dr. Buchanan, had "unmistakable affinities in its local phenomena with the Hendon cow disease, and in its constitutional manifestations with scarlatina in the human subject." The cow disease was ascertained by Dr. Klein to be characterised by the presence of a definite micro-organism in the affected tissues; and both the blood and tissues of ordinary human scarlatina have been found to exhibit organisms identical in their morphological characters and pathological properties with those which had been found in the case of the Hendon cow.

Summarising the information available on this subject, Dr. Buchanan, in his last report, states as follows:—"1. The disease in man and in the cow alike is characterised by

* Annual Report of the Medical Officer of the Local Government Board for 1886. [C.—5171], 1887.

closely similar anatomical features. 2. From the diseased tissues and organs of man and cow alike the same micrococcus can be separated, and artificial sub-cultures be made from it. 3. These sub-cultures, no matter whether established from man or cow, have the property, when inoculated into calves, of producing every manifestation of the Hendon disease, except sores on the teats and udders—no doubt for the reason that the milk apparatus is not yet developed in calves. 4. But—and this I have from Dr. Klein's later observations while this report is in preparation—the sub-cultures made from human scarlatina and inoculated into recently calved cows can produce *in those cows*, along with other manifestations of the Hendon disease, *the characteristic ulcers on the teats;* ulcers identical in character with those observed at the Hendon farm. 5. The sub-cultures, established either from the human or the cow disease, have an identical property of producing in various rodents a disease similar in its pathological manifestations to the Hendon disease of cows and scarlatina in the human subject. 6. Calves fed on sub-cultures established from human scarlatina obtain the Hendon disease. 7. Children fed on milk from cows suffering under the Hendon disease obtain scarlatina. . . . . The above combine, I think, to form a mass of evidence to show that the Hendon disease is a form, occurring in the cow, of the very disease that we call *scarlatina* when it occurs in the human subject."

Here, indeed, we have a chain of circumstances linked together with the scientific accuracy which is typical of that form of research which has, at various stages, led to the identification of disease in man with definite micro-organisms, and which forcibly calls to mind the keen forethought of those who in the early days of the Epidemiological Society laid it down as a leading principle that its "objects" should include "a knowledge of epizootics, or

epidemic diseases among the lower animals, whether contemporaneous or not with such diseases in the human family."

V.—Diphtheria.

Diphtheria is so often regarded as having certain affinities with scarlatina, that some consideration of its history may appropriately be included in this place; besides which, it is a disease which has the more interest for us because such study as it has received in this country has been carried out during the Victorian Era.

Diphtheria is known to have been epidemic on the continent of Europe during the 16th and 17th centuries; and, according to Sir John Simon, it was prevalent in England during the two middle quarters of the past century, there being also, later on, record of certain small local epidemics. But it was not until the summer of 1855 that the disease received much notice in this country. At that date an extensive epidemic prevailed in Boulogne, many English residing there being attacked. In September of the same year it was recognised at Launceston, Cornwall. In July 1856 it appeared in Lincolnshire; in 1857 and 1858 it was manifested in many parts of England; and from that date it has been an almost continuous and, generally speaking, an increasing cause of death amongst us.

In 1859 the disease was made the subject of a somewhat extensive inquiry by the Medical Department of the Privy Council; it was regarded as distinct from scarlatina, prevailing mainly, but by no means exclusively, in places either marshy or otherwise damp, and on cold, wet clay soils; it was distinguished by certain characteristic neuroses; and, though no definite connection could at that date be traced between the disease and any affection of the lower animals, it was reported by Dr. Greenhow to have been

found prevailing simultaneously with certain forms of disease affecting the mouth, lips, nose, etc., of certain lower animals, such as cattle and horses.

The etiology of the disease was, subsequently to that date, matter of frequent inquiry, such investigation as was made being, however, largely limited to single outbreaks. But, in 1880, Dr. Airy was instructed by the Local Government Board to make a somewhat comprehensive inquiry into the circumstances of new appearances of the disease in various parts of England and Wales, and some of the conclusions at which he arrived are as follows.

Whilst admitting that the disease was largely spread from person to person, especially amongst the young, Dr. Airy was much struck by the failure, in a great majority of the cases investigated, to trace any cause to which the several outbreaks could with any probability be ascribed; a failure which could hardly have occurred if it were the case that communication, direct or indirect, with previous human diphtheria were a necessary or even a habitual condition of a new outbreak of the disease; and he, in this connection, recalls the opinion of Dr. Burdon Sanderson, who, in 1859, reported that "the circumstances were frequently such as to shut out even the possibility of personal communication." Bearing upon this point, it is also noteworthy that diphtheria operates more frequently in sparsely populated country districts than it does in densely populated towns, where the facilities for intercommunication are at their greatest. Dr. Airy further reported that he had found appearances of the disease to be far more frequent in October than in any other month; that it had prevailed more frequently on clayey than on sandy soils; that it had a preferential incidence on families that had shown liability to throat-affections; and, taking note of the whole of the circumstances which had come under his notice, together with the discoveries of Oertel and Hüter,

he held that nothing short of a living organism capable of infecting milk and air, and of being transmitted by means of wind currents, could fully account for all that he had met with.

In many respects Dr. Airy's inferences were confirmatory of those of previous observers; and, amongst other things, he gives some support to the views which I brought under the notice of the Epidemiological Society in 1878, and in which I endeavoured to show, from the history of diphtheria, that there were grounds for believing that certain infectious diseases were not exclusively self-propagating, but did at times arise independently of antecedent cases in the human subject. The following are the passages in which I especially dealt with this subject.

"In isolated districts, and in houses situated at times many miles away from other habitations, and in some instances lying in lonely spots among mountain ranges, where a visit to or a visit from the nearest town or village would be a circumstance too important to be forgotten, I have met with instances of what appeared to me to be nothing more than a simple inflammation of the throat, at times so trivial that it has passed all but unnoticed, and yet it has led, by transmission through other persons, to cases of well-marked and severe diphtheria. The first attacks have often happened in children whose former movements could apparently be traced with the strictest accuracy; they have occurred under circumstances which did not appear to admit of previous infection; and it has been difficult to interpret their occurrence except on the supposition that in some way they have arisen independently of prior cases. With regard also to the well-marked attacks of diphtheria to which they seemed to give rise, all other sources of infection could be excluded with a degree of certainty rarely to be met with. And as to those first affected, whose cases appeared to be earliest in a series

which led up to attacks of well-marked diphtheria, it has more than once happened that they were children in whom so-called 'sore-throat' was a common affection, and whose fauces, when examined, exhibited a loss of tissue indicative of former throat-attacks."

"I have stated that instances such as these have been met with in connection with outbreaks of diphtheria, and it may therefore be inferred that the early cases were merely mild attacks of that disease, the poison of which had been received in some unascertained method; but every one of these instances occurred in persons living miles away from the apparently very limited infected localities, which in some cases were mere hamlets, and this source of error seemed to be one which could unquestionably be excluded. And, during the same investigations, I have noticed the fact that, over an area of some miles around the district in which genuine diphtheria was prevailing, there existed, prior to, as well as during, the diphtheria epidemic, numerous instances of sore-throats which, so far as an examination of the patients was concerned, in every way resembled the early cases above referred to, and yet which gave no indication of being infectious; sore-throat being, in fact, in the surrounding district a prevailing ailment. And I have hardly been able to refrain from drawing the conclusion that conditions very similar to those under which genuine diphtheria was epidemic in a limited district obtained, and had obtained, before genuine diphtheria was anywhere seen, over a wide area around the immediately infected locality; and that these conditions, leading to a somewhat general predisposition to simple and apparently non-infectious sore-throat, had, further, probably under somewhat modified circumstances, tended at certain points to produce an affection capable of putting on the property of infectiveness,

which thus lead to the transmission of the disease in a distinctly communicable form to others."*

"If this be a correct interpretation of the circumstances related, it would appear to indicate the possible occurrence of what may perhaps be looked upon as *the progressive development of the property of infectiveness.* And if the contagia of the acute specific diseases do—as has been suggested by more than one observer—belong to the vegetable world, I knew no grounds for refusing to believe that organisms capable of producing a minor and an uncommunicable disease in particular stages of their growth may, in other stages of their growth, or in the course of their subsequent development, become capable of producing a major disease communicable from person to person; the affair being essentially one of soil. This is not at all a question of the development of a living organism out of matter independently of antecedent life, but merely the production, by means of a process of evolution, of that which gives to an already existing organism that property by which it becomes infective—a property which it may perhaps lose directly it is deprived of the circumstances which favoured its development, in much the same way as special characteristics may be artificially developed in higher plant-life, and be as easily lost again."

Since I wrote the above, in 1878, circumstances have arisen which will make it necessary in the future, in seeking for antecedent infection, to look to the possibility of such infection being derived from the lower animals. But, apart from such consideration, additional evidence has, I think, been forthcoming in favour of the opinion that the contagium

* In this connection Dr. Gresswell's paper on "Diphtheria and its Liability to Recrudescence" deserves study. (See *Transactions of the Epidemiological Society*, vol. v, 1885-86.)

of diphtheria is often characterised by a want of stability when compared with that of other contagia, such as small-pox, and that it does affect the human subject in a form which is capable both of progressive development and of relapse in point of type, according to the circumstances of its surroundings.*

But whilst diphtheria may be regarded as not necessarily dependent in its origin on an antecedent human case of the same affection, yet its epidemic spread is largely due to personal intercommunication, and this especially amongst children between the ages of 3 and 12 years: an age incidence that necessarily involves the question of attendance at elementary schools. Numerous investigations have been made, which show the marked influence of school attendance and of age as a cause of diphtheria spread. In an outbreak on which I reported to the Local Government Board early in 1877, and in which no less than 170 diphtheria attacks had occurred in a population of 3,309 living at Great Coggeshall in Essex, 7·1 per cent. of the children between 0-15 years were attacked; between 0-3 years the attacks were at the rate of 4·0 per cent.; from 3-12 years they were 8·4 per cent.; and from 12-15 years 4·8 per cent.; the incidence of the disease upon children from 3 to 12 years being about 50 per cent. greater upon those known to have attended school than upon the remainder.† Much the same incidence of diphtheria on school-going children of the ages specified has been noted

* In his Morton Lecture, delivered before the Royal College of Surgeons on Nov. 11, 1887, Sir James Paget, in referring to the resemblances between innocent and cancerous tumours, and to the examples of intermediate forms occupying the space between the two extremes, refers to this "gradation" as affecting "all groups of diseases". His remarks on this point deserve study in this connection.

† Dr. Downes's "Contributions to Diphtheria", in *The Practitioner*, vols. xxxi and xxxii, are of great interest in this connection.

elsewhere; and at times school attendance has appeared to have constituted a very important factor in the recrudescence of the disease, and in imparting to it special characteristics. Mr. W. H. Power's report, in 1882, on an epidemic in Pirbright is very instructive from this point of view.*

"On four successive occasions while the village school was open, well-marked diphtheria occurred among the scholars . . . .; and this although the school premises were free from recognisable sanitary defect; and although the school was not, after its first closure, reopened until the disease had seemed extinct in the parish, and careful measures of disinfection had been used." But, beyond this, the reopening of the school appeared on each of four occasions to be responsible for giving a serious quality to the resulting diphtheria, and this although the assembling of the children only took place some weeks after the disease had apparently subsided, and when skilled investigation, subsequently carried out, could only detect the existence of certain neuroses amongst convalescents and a few attacks of so-called "colds". On each occasion, and "with startling suddenness", multiple cases of diphtheria, and fatal diphtheria, promptly occurred, and this without the intervention—except perhaps at one period—of cases of intermediate gravity. Indeed, there are grounds for believing that the aggregation together of cases of diphtheria and of allied throat-affections under circumstances such as those obtaining in elementary schools constitutes one of the conditions under which a form of disease of particular potency for spread and for death may be, so to speak, manufactured.

And, as far back as 1878, during an epidemic of diphtheria in North London, Mr. Power connected the incidence of the disease with the distribution of a certain milk-supply; and

* Report of the Medical Officer of the Local Government Board for 1882. [C.—3778—I], 1883.

this under circumstances which raised the question whether the cow herself might not have been concerned in the infection of the milk.

In 1883, again, evidence that may be regarded as conclusive was forthcoming to show that diphtheria was capable of being brought about by the distribution of milk from a particular dairy; and in referring to two such outbreaks, investigated respectively by Mr. Power at Hendon and Dr. Parsons at Devonport, in 1883, Dr. Buchanan says, in his report for that year, that "at Hendon it was difficult to refuse this explanation of the facts, since the milk at the very time it was operative for harm . . . exhibited a peculiar ropiness and unpleasant taste, which caused some of its habitual customers to return it to the dairy; and for these phenomena no condition about the dairy or its utensils could be regarded as responsible." Here it was again foreshadowed that diphtheria in man might have relation to some disease in the cow; and it is well at this stage to recall the fact that different observers had, even before this date, expressed suspicion that the contagium of the disease might be due to conditions affecting the brute creation, and that others had associated it with fungoid growths of a vegetable character.

Amongst the latest developments of these views I would call attention to several reports. First, there is one presented by Dr. Simpson to the Local Government Board in 1885, on diphtheria in and about Shaftesbury. In it he refers especially to an outbreak, in three successive Novembers, in an old, dilapidated house, standing in a water-logged soil, where the walls of the ground and upper floors were found to be wet and covered with moulds, and the woodwork rotten. "There could scarcely", he adds, "be a more favourable soil for the growth of lower forms of vegetable life."*

* See also a paper by Dr. Michael W. Taylor, in *Transactions of the Epidemiological Society*, Session 1886-87.

Next, there is the contribution by Dr. George Turner on his experiences of diphtheria, especially in its relation to the lower animals, embodied in Dr. Buchanan's report for 1886. And, lastly, in the same volume, that by Mr. Power on diphtheria at York Town and Camberley. In this latter case the outbreak was ascertained to have been due to milk which had clearly received its infectiveness before it left the farm where it was produced; but the incidence of the disease on the better class of consumers, as compared with the cottagers and trades-folk, was as 29·3 to 6·2; and, it having been ascertained that this excess of disease was brought about apart from the use of cream, it became apparent that the *amount* of milk consumed, involving, as it did, *inter alia*, differences of *number of opportunities* for infection, had been all-important in bringing about this result. And, again, the better-class people stored their milk, and did not, like the other class, use it directly after purchase; and thus an opportunity was given in the former case for the development and multiplication of any infective material present in it, and so of giving to the milk a superior ability to convey infection.

In this case there was a complete absence of evidence as to infection of the milk directly by human agency, or owing to unwholesome conditions at the farm; but, as regards disease in the cow, it could only be stated that the outbreak had been related in point of time to the process of calving and "cleansing" in two of the cows belonging to the dairy-farm, and to the existence in another cow of a "scab or crust", not unlike those which at a later stage of their malady had been observed to replace ulcers on the udders of certain Hendon cows referred to in connection with scarlatina.

The etiology of diphtheria is thus still involved in considerable obscurity. By some the disease is regarded as having distinct alliance with scarlatina, there being no

clearly defined boundary-line dividing affections which, in their more marked forms, present obvious differentiating characteristics; and the views which were expressed by Dr. Franklin Parsons, in the paper which he read before the Epidemiological Society during the Session 1883-84, are worthy of careful consideration in this connection. It is also interesting to note that, whilst in the three quinquennial periods ending 1885 there was a diminution in the scarlatina death-rate for England and Wales, there was a coincident increase for that of diphtheria. Thus, for the periods 1871-75, 1876-80, and 1881-85, the scarlatina death-rate per 100,000 living in England and Wales was 75·8, 67·9, and 43·4 respectively, whereas the corresponding diphtheria rates were 12·1, 12·2, and 15·6.

How far this may be a question of nomenclature brought about as the result of improved diagnosis it is difficult to say; but there can be but little doubt that, quite apart from any such consideration, there is evidence to show that, for some cause or another, diphtheria has, during recent years, exhibited a tendency to increase, and to acquire a more permanent stability of type amongst us. Yet there is reason for some confidence that the study devoted to the etiology of the disease, especially during recent years, has tended towards the ultimate discovery of those measures by means of which a substantial check may before long be put upon the increasing fatality of diphtheria.

VI.—Phthisis.

I believe that the first comprehensive report relating to the prevention of pulmonary phthisis which was made during the present reign was that which Dr. Greenhow prepared, in 1858, and which was submitted by Mr. Simon to the President of the General Board of Health. In addressing the President, Mr. Simon stated that "pulmonary

affections, including phthisis, cause very nearly a quarter of the annual mortality of England. Every 100,000 of our population yields on an average 552 annual victims to this deadly class of disorder." He also expressed the opinion that pulmonary phthisis then killed, on an average, in England more than 50,000 persons a year, in addition to some 8,000 others, whose deaths were set down to such causes as scrofula and tabes mesenterica; and he urged the need for further study of this disease and its causes, not alone because of its cruel mortality, but because of the tendency of tubercular disease to transmit itself from parent to child; and he added, that "whatever tends to increase tubercular disease among the adult members of a population must be regarded as assuredly tending to produce a progressive degeneration of race."

The investigation which was made at that time went to show, amongst other things, that "in proportion as the male and female populations are severally attracted to indoor branches of industry, in such proportion, other things being equal, their respective death-rates by phthisis are increased"; that imprisonment and barrack-life, under the then circumstances, exerted a considerable influence in inducing the disease; that inadequate ventilation, both in and about dwellings, was a factor in the disease; and that high phthisis death-rates were associated with certain branches of industry, in which sustained irritation of the air-passages was brought about, as, for example, by the diffusion in the atmosphere of the work-places of particles of materials used in the manufacturing processes, and in which the operatives were exposed to marked vicissitudes of temperature.

This inquiry was continued under Mr. Simon, after he was appointed medical officer to the Privy Council; and in his 3rd and 4th annual reports he published the details of an investigation, the result of which had for its object to elicit

the influence of certain branches of industry on the production of phthisis. The summary of this inquiry, as set out in the 4th report, refers to the following as some of the more important influences at work in producing the excess of disease and death in question.

In the first place, and generally affecting most of the callings and pursuits, the unwholesomeness of work-rooms, through want of ventilation, stood out prominently—this evil obtaining "from the humblest cottage industry even up to the highest development of our factory system". Adding to the mischievous results of this lack of ventilation were conditions such as the vitiated products of combustion following on the use of artificial light; the methods of heating, other than by open fire-places; and the failure to rid the air of injurious dust and other matters. Another cause of phthisis was found to be the sedentary nature of many employments, and often the constrained bodily posture. Numerous details in connection with various methods of manufacture were cited in support of these views, and a number of remedial suggestions were made, which have since been widely acted upon, with a result of substantially diminishing the risk of pulmonary phthisis in a large number of callings.

I have already referred, in connection with enteric fever, to an inquiry which was made by Dr. Buchanan in 1865-66, under the instructions of the Privy Council Office, and by which it was sought to ascertain what had been the results obtained by local authorities, who had, by means of such works as water-supply and sewerage, sought to improve the public health within their jurisdiction. One main purpose of the inquiry was, "that the then Central Public Health Authority should fulfil one of the principal duties expected of it by making new local experiences conducive to general enlightenment"; and this object was, in one important

respect, attained in an altogether unexpected direction. That the prosecution of such works as have been referred to should have led to a diminution in the general death-rate, as well as in that for certain of the infectious fevers and allied diseases which are known to be intimately associated with pollution of air, soil, and water, was indeed to be anticipated; but as the inquiry progressed it became obvious that an influence had been exercised by such works on the amount of mortality from pulmonary phthisis; and in the end it became clear that "the drying of soil", which had, in most cases, accompanied the laying of main sewers in the improved towns, "had led to the diminution, more or less considerable, of phthisis mortality."*

Some brief summary of the results of Dr. Buchanan's inquiry, in so far as it relates to phthisis, will be of interest. Amongst the towns visited there were many in which a striking diminution had taken place in the phthisis mortality; that diminution being not only, at times, the largest amendment discovered, but it had taken place at a period which must necessarily have preceded, by some years, the accomplishment of such objects as the construction of proper house-drains, the abolition of cesspools, etc. Indeed, it was quite evident that any mere improvement in the methods of dealing with excreta and refuse, both solid and liquid, the bringing in of new water-supplies, and a host of other conditions that were considered, bore no necessary relation to the improvement effected. But a distinct etiological connection was established between local dampness of soil and phthisis. Where drying of soil had resulted from works of sewerage, there the phthisis mortality had undergone diminution; where no such drying of soil had as yet been brought about, there no improvement as to phthisis had been

* Ninth Report of the Medical Officer of the Privy Council, with Appendix, 1866.

effected; and not only so, but the amount of reduction in the phthisis mortality appeared largely dependent on the extent to which permanent drying of soil had been brought about. The results recorded, as regards Leicester and Chelmsford, afford crucial proof of these contentions. In the case of Leicester, we have a town "in the main situated on a saucer of loam, principally stiff clay", and formerly having an undrained subsoil and "a wet surface". In these circumstances it had, for a series of years before the execution of any sanitary works, a mortality from phthisis amounting to 43⅓ per 10,000 living; during six years, in which 30 miles of sewers were constructed, the rate fell to 25⅙; though, after the completion of the sanitary works, it rose again to 29¼; the comparatively small rise during the third period here referred to corresponding, doubtless, with a damper state of subsoil than that which obtained during the period when the works were in actual progress, and when the stiff clay was intersected with deep trenches for the reception of the sewers. Chelmsford, on the other hand, lies at the confluence of the rivers Chelmar and Cann; the town being situated on a gentle incline on a bed of gravel, some 15 to 30 feet in depth, overlying the London clay. In 1853 works of sewerage and water-supply were commenced. During the ten years preceding that date there had been a death-rate from phthisis of 32⅓ per 10,000; whilst the works were in execution—a time when certain wells were dried—the rate exhibited a slight fall to 30⅓; but the rate for a period of eleven years after their completion practically reverted to its previous state, and is recorded as amounting to 32⅔ per 10,000. In the case of Chelmsford the sewers are deep and the soil is porous; and it is under these circumstances that drying of soil is most likely to take place. But, half a mile below the town, on the river Chelmar, stands a mill having flood-gates, with which the mill-owners alone have a right to deal; by means

of these the subsoil water of Chelmsford is artificially kept up, and, at the date of the report, fogs prevailed in the meadows; and the town was, in winter, surrounded on more than one side by marshy lakes. Both Leicester and Chelmsford thus teach the same lesson, although the data are altogether different. At the close of his inquiry Dr. Buchanan learned that Dr. Bowditch, during the course of an inquiry as to the causes of consumption in Massachusetts, had come to conclusions similar to his own; and it is needless to add that the circumstance of two observers having, independently of each other, arrived at precisely similar results gives additional importance to the discovery made.*

The discovery was, indeed, of the utmost value. It afforded indications as to the prevention of phthisis which it soon became impossible to ignore; and we see some of their developments both in the efforts made, by works of drainage and otherwise, to reduce the level of the sub-soil water of towns and villages, and in those codes of bye-laws which require that the ground surface of every domestic building shall be covered with a layer of cement concrete, and that a damp-course shall always be so placed in the

* I am aware that, in his sixth report (1879) on the Combined Sanitary District of West Sussex, Dr. Charles Kelly, basing his views on certain experiences derived from that rural area, has expressed a doubt as to the correctness of these conclusions. He states that the phthisis death-rate had been "distinctly lowered" in that district "in recent years", "while very little, if any, change has taken place during the same period in the drainage of the soil." Without entering into any criticism of some of the statistical data brought forward by Dr. Kelly in support of his views, I would here merely note, 1st, that the large amount of agricultural drainage which had then already been effected throughout the kingdom would be expected to have produced a very similar result in rural districts to that brought about by sanitary drainage in towns; and, 2nd, that Dr. Kelly offers no explanation of the definite and striking relation shown by Dr. Buchanan to have existed between the amount of diminution of phthisis death and the extent and permanence of the lowering of sub-soil water.

walls of such buildings as to be beneath the level of the lowest timbers. The value attaching to residence at high altitudes, and in a dry atmosphere, also receives significant explanation as the result of Dr. Buchanan's inquiry. Indeed, it may be asserted that, on the lines indicated by the results of the several inquiries to which I have adverted, vast improvements have been going on, which have influenced health and life in town and village, factory, workshop, and home, to a degree that has already materially diminished the production of pulmonary consumption, both in this country and in many parts of the world.

Unfortunately, confusion between pulmonary phthisis and other diseases of the respiratory organs has not, even at this date, been eliminated from our mortality returns; and comparative statistics as to these several diseases are further vitiated by reason of changes in nomenclature which have followed on improved diagnosis. But, at the same time, some indication of the improvement I have referred to may reasonably be assumed to underlie the figures included in the following table, which shows the annual mortality per million from "phthisis" at all ages, and at certain typical ages in both sexes during the last three *decennia.*

PHTHISIS IN ENGLAND AND WALES.

	All Ages.	15—	20—	25—	35—
1851-60	2679	2961	4181	4317	4091
1861-70	2475	2651	3928	4243	4026
1871-80	2116	2036	3117	3619	3745

I cannot quit this subject without making some reference to the investigations which are being made in this country, in Germany, in the United States, and elsewhere, as to the etiological relationship of bovine and human tuberculosis; and to the allegations of some observers, that bovine tuber-

culosis may be communicated to man as the result of the use of milk of cows suffering from that disease, and even that human tuberculosis has a source in the use for food of the flesh of tuberculous animals. So far, the propriety of accepting the probability of such transmission of this infective disease appears to depend materially on the question of the identity of bovine and human tuberculosis, as to which different views are entertained. But the fact that the milk of tuberculous cows has, apart from certain complications, not yet been found to contain tubercle bacilli, alone forms a ground for suspending judgment on this important point.

VII.—Cholera.

The history of cholera in this country is very intimately associated with the story of progress in the department of public health and of sanitary medicine. As already stated, the first appearance of cholera in England was in 1831-32, before the commencement of the Victorian era. The disease reached this country by way of the Baltic, first attacking several of our eastern ports in the autumn of 1831, and becoming widely diffused in the following year. Unfortunately, no accurate information is available as to the extent of its ravages. But that invasion led to an important movement in the direction of sanitary reform, and of legislation to effect that object; such legislation being largely based upon the skilled observations of those who had recorded the circumstances under which cholera had prevailed in this country.

The second great visitation of cholera occurred in 1849. On the occasion of this epidemic, cholera, after having extended its destructive course over the eastern part of Europe, penetrated into Prussia, Hamburg, and Holland, and, in September 1848, crossed the German Ocean, and

broke out in several towns in Scotland and England. At first the progress of the disease was slow and irregular; the total deaths in England numbering 988 from the date of its first appearance, in 1848, to the end of March 1849. But between June and the middle of September of that year there was a rapid increase, after which the disease gradually declined, and finally ceased in December. In all, the fatal attacks during 1849 numbered 53,293, in addition to 18,887 diarrhœa deaths; and, from the literature in which the epidemic is recorded, it is evident that there was recognition at this date of the circumstance that its spread was largely facilitated by conditions of filth, affecting air, soil, and water. In the words of the Royal Sanitary Commission, 1869: "The reports then made by the medical officers who had been established . . . . clearly traced the most fatal ravages of the epidemic to the crowded alleys of large old towns, impure air and water, and foul streams." And whilst the diffusion of the disease was largely dependent on human intercommunication, direct or indirect, it was found to differ in its mode of spread from such affections as typhus and small-pox.

In August 1853 cholera appeared again in London; in September it was widely prevalent in Newcastle, Gateshead, and other places in Great Britain; and in the following year, 1854, England suffered from a third great epidemic of this disease. Cholera in this country had again followed on an epidemic spreading from Russia, through Norway, Sweden, and Denmark, and the Baltic ports of Germany, from whence it was communicated to this country.

In the metropolis the disease was maintained during September, and in the months of October, November, and December 1853 the fatal attacks were 335, 288, and 43 respectively. From January to June 1854 only occasional deaths took place; but during the last three days of July no

less than 138 fatal attacks occurred. From this latter date there was a rapid rise in the amount of cholera and diarrhœa fatality. The epidemic spread in various parts of the kingdom, and by the close of the year the total deaths from cholera in England and Wales had numbered 20,097.

Dr. Snow was amongst the earliest contributors to the etiology of cholera in this country. He had previously dealt with the epidemics of 1832 and 1849, in connection with the theory of water-pollution. As regards the 1832 epidemic, he had maintained that its exceptional incidence, in certain localities, was in large part due to the polluted water in use in London, whether derived from wells liable to receive cesspool soakage or from the sewage-contaminated Thames. Between 1832 and 1849 cesspools had been largely abolished, but water-closets, the contents of which passed into the Thames, had replaced them, with the result of bringing about a state of river impurity far exceeding that of 1832. And during the 1849 epidemic the parts of the metropolis most heavily visited were those within the area of the Lambeth and the Southwark and Vauxhall Water Companies on the south side of the river, their supply being then the worst of all those derived from the Thames. The "contamination of pump-water" was also ascertained to have been associated with the spread of the disease. And now again, in 1854, Dr. Snow pointed to the proof which the incidence of cholera afforded " of the powerful influence which the drinking-water containing the sewage of a town exerts over the spread of cholera". Between 1849 and 1854 important changes had taken place in the water-supply of the metropolis. The Lambeth Company had sought a supply higher up the river, and, to quote Mr. Simon,* that Company was now "furnishing as good a water as any distributed in London"; while its

* Report addressed to the President of the General Board of Health in May 1856, by the Medical Officer of the Board.

southern colleague, the Southwark and Vauxhall Company, "was purveying perhaps the filthiest stuff ever drunk by a civilised community". Here were materials for comparison, and the result was as follows:—On a population of 166,906 persons living in houses supplied by the Lambeth Company, the cholera deaths were at the rate of 37 to every 10,000 living; whereas, on 268,171 persons supplied by the Southwark and Vauxhall Company, they were at the rate of 130 per 10,000. "The population drinking dirty water accordingly appears to have suffered 3½ times as much mortality as the population drinking other water."

It was during this epidemic that the circumstances occurred which have made the pump in Broad Street, Golden Square, historic in the annals of English cholera. According to Dr. Snow,* 89 cholera deaths were registered in three sub-districts in the week ending September 2nd, 1854; 79 of these occurring in the two last days of that week, and "nearly all" in persons residing within a short distance of that pump. Indeed, "except among the persons who had been in the habit of drinking of the . . . . pump-well", there had been no particular outbreak or increase of cholera in that part of London. It was a celebrated pump. "The water was used for mixing with spirits in all the public-houses around. It was used likewise at dining-rooms and coffee-shops . . . . it was also used at various little shops" in the making of sherbet. And amongst occasional consumers of it, some living at a distance from the pump, numerous fatal attacks occurred; whilst, on the other hand, the disease was markedly absent from several large groups of people living in the immediate neighbourhood, in institutions or other places having a different water-supply.

But it also became recognised that polluted water was by no means the sole cause of cholera spread. Dr. Greenhow,

* Snow, *On Cholera*, 1855. London, John Churchill.

in reporting to the General Board of Health, pointed out that the mortality had also "generally borne a direct ratio to the amount of atmospheric contamination"; and although some of the channels by which the poison operated in its various wanderings still remained undiscovered, yet observers, such as Mr. Simon, detected the operation of "specific influences", with capability for propagation, such as is exhibited by "ferments", in the presence of conditions of filth affecting air, soil, and water.

It was as a sequel to this epidemic that the need for a medical adviser to the State was recognised by the appointment of Mr. Simon as Medical Officer to the General Board of Health.

The fourth cholera epidemic from which this country has suffered took place in 1866. As on the occasions of the former epidemics, the disease manifested itself in the year immediately preceding its wide diffusion. But it entered this country by an altogether different route. Early in 1865 cholera was causing an appalling mortality amongst the Mecca pilgrims, and from Mecca it was diffused into Egypt, and thence along the lines of steam-boat communication between Alexandria on the one hand, and the Levant and Southern Europe on the other; extension subsequently taking place in a more northward direction. Ultimately the disease manifested itself in Southampton, on more than one occasion, during the month of July 1865; this extension being probably connected with arrivals from Alexandria, Malta, and Gibraltar; and being the first occasion in which cholera had entered the kingdom by way of our southern coast. After these preliminary warnings, a definite outbreak, involving some sixty persons, took place in Southampton during September–November; and cases also occurred at other places, such as Weymouth, Portland, Dorchester, and at Theydon Bois in Essex.

Towards the close of April 1866, a trader arrived at Bristol from Rotterdam—sick of the disease; in May, German and Dutch emigrants had conveyed the infection to Liverpool. Birkenhead and Swansea were next attacked. In June the *Poonah* arrived at Southampton with the disease on board; and England was evidently developing cholera at various points. Then came the invasion of London, the first death being returned from Poplar on July 18th,* after which the disease spread rapidly. The story of this epidemic has been told in detail by the late Mr. Netten Radcliffe, who also, as the result of a laborious inquiry, came to the conclusion that the exceptional incidence of the disease in the eastern districts of London was the result of the distribution by the East London Water Company of a polluted water, which had "in it a power of direct infectiveness for those who drank it". During the course of 1866 the cholera deaths amounted to 14,378 in England as a whole; 5,548 of these occurring in London.

The circumstances of the 1866 epidemic acted as a great stimulus to epidemiologists in various parts of Europe to study afresh the conditions under which cholera prevailed, and to obtain a knowledge of the right principles of defence against it; the practical sanitary experiences gained in England being especially supplemented by the labours of distinguished German pathologists, who, at that date, sought for the essential cause in some fungoid growth. In this country it had been conclusively shown that the laws of cholera contagion bore a striking resemblance to those relating to enteric fever, and that, to quote the words of Mr. Simon, "excrement-sodden earth, excrement-reeking air, excrement-tainted water, these are for us the causes of cholera."

* Reports of the Medical Officer of the Privy Council for 1865 and 1866.

But though this lesson had been brought home more convincingly than ever, it was not a new one; and for many years past a movement—often but too slow—had been on foot towards the removal of those conditions of filth which had been found to be essential to the diffusion of the cholera infection. And we have a right to assume that it was largely owing to these labours that the power of the disease for harm had become less and less during its last three visitations. This result is shown in the following table:—

CHOLERA MORTALITY.

Date.	England and Wales.		London.	
	Total Deaths.	Deaths per 10,000 living.	Total Deaths.	Deaths per 10,000 living.
1849	53,293	30	13,565	51
1854	20,097	11	10,684	43
1866	14,378	7	5,548	18

Since 1866, cholera, though more than once brought to our shores—as during the European epidemics of 1871-74 and 1884-87—has never succeeded in establishing itself in our midst, a result which is no doubt due to the steady removal from amongst the people of those insanitary conditions which are essential to its epidemic spread, and to the increasing security afforded by those measures of imperial and local sanitary administration by which it is sought to diminish sickness and mortality from all preventable diseases, including cholera.

The beneficial results which have ensued in regard to the saving of life from cholera have, in no small measure, been due to the fortunate abandonment by this country of all endeavours to keep cholera away from her shores by a system of quarantine. I recently brought under the notice of the Epidemiological Society the attitude we have finally adopted in this matter, in a record of the Proceedings of the International

Sanitary Conference of Rome, 1885, which I had the honour of attending as one of the delegates of Her Majesty's Government.* It is one of distinct opposition to the entanglement of this country by means of a delusive system, offered anew under the plea that another reduction should be effected in the duration of a detention which, even under its most stringent forms, had been mainly characterised by ever-repeated failure; and I would now only refer to a summary of the grounds on which I justified this opposition when dealing with this subject at the meeting of the British Medical Association in 1887. I concluded by observing that "the system of quarantine has again and again shown itself to be impotent for good, and, being so, its vexatious and inhuman characteristics stand out the more prominently. Above all, it has a blighting effect upon sanitary progress. So long as Governments tell their peoples that a line shall be drawn around them across which disease shall not pass, so long will those peoples be reluctant to spend their money on the promotion of true measures of prevention. The quarantining countries are essentially those which cholera invades. Taken as a group they are those where true sanitary progress is at its lowest ebb; and, with the experience we have before us, I would, in conclusion, ask, much in the words I used at the Rome Conference: Is it likely that this nation will sacrifice her well-tried system of prevention for a restriction of five days' quarantine?"

I cannot close this subject without referring to one noteworthy contribution to the etiology of cholera, which has recently been made by Dr. W. J. Simpson,† Health Officer for Calcutta. An outbreak of cholera having occurred on

* *Transactions of the Epidemiological Society*, vol. v, New Series. Session 1885-86.

† Report on the Health of the town of Calcutta, for the first quarter of 1887.

board the *Ardenclutha*, which was moored in the river, he succeeded by a process of elimination in at last tracing the disease to the use of a certain milk-supply. Fourteen of the crew who had not partaken of this milk remained altogether free from sickness; whereas, of ten who had drunk it, nine, or ninety per cent., sickened, four with fatal cholera, and five with "diarrhœa"; the one who escaped having only drunk a "thimbleful". The milk-supply being stopped, all sickness was stayed. In this case the milk—which was procured from a distance, namely, from Howrah, on the other side of the river Hooghly, and had been brought on board by a native—was admittedly and somewhat copiously diluted with the contents of a tank polluted with cholera excreta. Cases of cholera occurred amongst the natives using the tank water directly after the contamination took place, and this localised outbreak at Howrah was simultaneous with that on board the *Ardenclutha*. This is, I believe, the only case on record in which milk has been definitely ascertained to have served as a vehicle for cholera transmission.

I am deeply conscious of the shortcomings of this record. The time at my disposal has of necessity placed limits on its completeness, and has compelled me to omit all but the most cursory reference to labours and discoveries which are calculated to exercise a most important influence on public health in the future, and which are identified with the names of many with whom we have been and still are associated. One such omission will, I am glad to say, speedily be supplied by Dr. Klein, who will shortly bring before us the subject of "The Infectious Diseases common to Man and the Lower Animals". We have also in prospect a communication which

will bring our information as to the relation of micro-organisms to preventable disease up to current date.

The complete story of the progress of sanitary medicine during the memorable period under discussion would carry us far beyond such bounds as I have had to place upon myself. It extends to the saving of human life, as the result of advancing knowledge, in every quarter of the globe; and those whom I address, having, during the best years of their lives, devoted singular gifts to epidemiological research in every portion of this great Empire, may well remember with satisfaction how our Society has been the repository of learning that has so largely tended to the lessening of death, which has been so distinguishing a characteristic of the past half-century.

If we need any fresh incentive to our labours we have but to compare the terrible death-roll of the past with that diminished mortality which has gone hand-in-hand with the scientific application of the principles of sanitary medicine to the circumstances under which we live. And when we look at the recent advances in our knowledge of the intimate nature of infection, and of the still hidden, but yet far-reaching, influences of disease, we are further stimulated to enter into friendly rivalry with those to whom the laurels of the past have so deservedly fallen.

It has, indeed, been contended that there are limits beyond which the saving of human life is not consistent with the public welfare, and that the present tendency is towards an undue multiplication of the human race, and to a corresponding increase of poverty and misery. But I venture to assert that, so long as the work we are engaged in goes, as it has gone hitherto, to the lessening of death, so long must it ensure the diminution of sickness, and a corresponding promotion of a higher vitality, and a greater capacity for remunerative work amongst the living.

And our determination to continue in a labour so full of promise will have the more binding force as we recall the progress which has marked a reign on which we, in common with the great British world, look back to-day with feelings of pride and loyal affection.

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